Section 4
Transmission Line Safety and Nuisance

4.1 Transmission Line Safety and Nuisance

4.1.1 Introduction

Riverside Public Utilities (RPU) proposes to build and operate a nominal 96-megawatt (MW) simple-cycle power plant on a 12-acre fenced site within the City of Riverside, California. The proposed facility is referred to as the Riverside Energy Resource Center (RERC) Project (Project). RPU will develop, build, own and operate the facility. RERC will supply the internal needs of the City of Riverside during summer peak electrical demands and will serve the City's minimum emergency loads in the event RPU is islanded form the external transmission system. No power from RERC will be exported outside of the City.

This analysis is intended to evaluate the potential for Project impacts during construction and operation. This document presents a summary of relevant laws, ordinances, regulations and standards (LORS), the Project's setting, potential environmental impacts and proposed mitigation measures affecting transmission line safety and nuisance. Required permits and permitting agencies are also identified.

4.1.1.1 Project Description

The proposed site is owned by the City of Riverside and is located adjacent to the City of Riverside's Wastewater Treatment Plant (WWTP) in a light industrial/manufacturing area. The RERC will consist of two aero-derivative combustion turbine generators with SCRs, an on-site substation, approximately 1.75 miles of 69kV transmission line, natural gas and water supply interconnection, and on-site administration building and warehouse. The power plant and associated administration building and warehouse will occupy approximately 8 of 12 acres with the additional 4 acres reserved for equipment storage and construction parking. The entire plant perimeter will be fenced with a combination of chain-link fencing and architectural block walls.

In general, the proposed site is flat with slight slope from south to north. This site is located approximately 2,900 feet north of the Riverside Municipal Airport. The nearest noise-sensitive receptor to the plant is a subdivision of single-family residential dwellings located 4,800 feet to the East of the plant. The line intercept point for the new line is located approximately 400 feet outside of Mt. View Substation. From the intercept point, the double-circuit 69kV line will extend approximately 9,000 feet to the RERC facility. The lines will cross the railroad tracks on Sheppard Street and will be routed along the east side of Sheppard Street to Jurupa Avenue (approximately 600 feet). The line will continue along the south side of Jurupa Avenue to Payton Street (approximately 8,000 feet) where the line will extend along the east side of Payton Street to RERC (approximately 600 feet). The existing 12kV underbuild along the south side of Jurupa

Avenue will be transferred to the new 69kV structures. The line route is generally in a Light Manufacturing zone (M-1), with a portion running along Jurupa Avenue and Sheppard Street that constitutes the boundary between Light Manufacturing (M-1) and Single-family Residential (R-1). The R-1 zoned portion begins approximately 6,000 feet after leaving the plant and is approximately 3,000 feet in length.

4.1.2 Laws, Ordinances, Regulations and Standards (LORS)

LORS for electric and magnetic fields, hazardous shock, communication interference, aviation safety and fire hazard are presented in Tables 4.1-1 through 4.1-6.

Most states do not have specific regulations regarding electrical effects of transmission lines. Only Florida, Minnesota, Montana, New Jersey, New York and Oregon have published guidelines or standards for electric fields or magnetic fields. The following table lists these published standards.

Table 4.1-1 State Guidelines for Electric Effects

State Transmission Line Standards and Guidelines				
	Electric Field		Magnetic Field	
State	**On R.O.W.***	**Edge R.O.W.**	**On R.O.W.**	**Edge R.O.W.**
Florida	8kV/m[a] 10kV/m[b]	2kV/m	-	150 mG[a] (max. load) 200 mG[b] (max. load) 250 mG[c] (max. load)
Minnesota	8kV/m	-	-	-
Montana	7kV/m	1kV/m[e]	-	-
New Jersey	-	3kV/m	-	-
New York	11.8kV/m 11.0kV/m[f] 7.0kV/m[d]	1.6kV/m	-	200 mG (max. load)
Oregon	9kV/m	-	-	-

*R.O.W. = right-of-way (or in the Florida standard, certain additional areas adjoining the right-of-way).
kV/m = kilovolt per meter. One kilovolt = 1,000 volts.
[a] For lines of 69-230kV.
[b] For 500kV lines.
[c] For 500kV lines on certain existing R.O.W.
[d] Maximum for highway crossings.
[e] May be waived by the landowner.
[f] Maximum for private road crossings.

The most stringent of these guidelines is the Montana guideline for electric field and the Florida guideline for magnetic field. The proposed 69kV transmission line will have a maximum calculated electric field of 0.628kV/m on the right of way, and 0.136kV/m on the edge of the right of way. The maximum calculated magnetic field would be 72.68 mG on the right of way and 41.3 mG on the edge of the right of way. In all cases, the values calculated for the proposed 69kV transmission line fall well below the maximum allowed by any of the other state standards and guidelines.

Table 4.1-2 Electric and Magnetic Field LORS

LORS	Applicability
ANSI/IEEE Standard 644-1994 "Standard Procedures for Measurement of Power Frequency Electric and Magnetic Fields from AC Power Lines"	Describes standard procedures for taking EMF measurements for an electric line that is in service.
CPUC Decision 93-11-013.	CPUC position on EMF reduction..
General Order 52 (GO-52), CPUC, "Construction and Operation of Power and Communication Lines"	Defines aspects of the construction, operation and maintenance of power and communications lines and specifically applies to the prevention or mitigation of inductive interference.
General Order 131-D, CPUC, Rules for Planning and Construction of Electric Generation, Line and Substation Facilities in California"	CPUC construction-application requirements including requirements related to EMF reduction.

Table 4.1-3 Hazardous Shock LORS

LORS	Applicability
Title 8 CCR, Section 2700, "High Voltage Electrical Safety Orders"	Defines minimum requirements and standards for installation, operation and maintenance of electrical facilities to provide practical safety and freedom from danger.
ANSI/IEEE Standard 80-2000, "Guide for Safety in AC Substation Grounding"	Provides guidelines and calculations to design a safe and effective electrical grounding system within an electrical facility.
NESC, ANSI C2, Section 9, Article 92, Paragraph E: Article 93, Paragraph C	Defines grounding methods for electrical supply and communications facilities.

Table 4.1-4 Communication Interference LORS

LORS	Applicability
Title 47 Code of Federal Regulations (CFR), Section 15.25, "Operating Requirements, Incidental Radiation"	Prohibits operations of any device from emitting incidental radiation that causes interference to communications. The regulation also requires mitigation to any device that does cause interference.
CEC stag, Radio Interference and Television Interference (RE-TVI) Criteria (Kern River Cogeneration Project 82-AFC-2, Final Decision, Compliance Plan 13-7)	Prescribes the CEC's RI-TVI Mitigation requirements, developed and adopted by the CEC in past cases.
NESC, ANSI C2, Section 9, Article 92, Paragraph E: Article 93, Paragraph C	Defines grounding methods for electrical supply and communications facilities.

Table 4.1-5 Aviation Safety LORS

LORS	Applicability
Title 14 CFR Part 77"Objects Affecting Navigable Air Space"	Defines criteria used to determine whether a "notice of Proposed Construction or Alternation" (NPCA, FAA Form 7460-1 is required for potential obstruction hazards.
Public Utilities Code (PUC), Sections 21656-21660	Discusses the permitting requirements for construction of possible obstructions near aircraft landing areas, in navigable air space and near the boundary of airports.
Federal Aviation Administration (FAA) Advisory Circular No. 70/7460-1G, "Obstruction Marking and Lighting"	Defines the FAA standards for marking and lighting of obstructions as identified by Federal Aviation Regulations Part 77.

Table 4.1-6 Fire Hazards LORS

LORS	Applicability
Title 14 CCR, Sections 1250-1258, "Fire Prevention Standards for Electric Utilities"	Provides specific exemptions from electric pole and tower firebreak and electric conductor clearance standards and specifies when and where standards apply.
ANSI/IEEE Standard 979, "Guide for Substation Fire Protection"	Provides guidelines for design and equipment deemed necessary for the fire protection of substations.
General Order 95/128, "Rules for Overhead Line Construction"	Provides requirements for electrical overhead construction in California.

4.1.2.1 Electric and Magnetic Field Definitions

Electric and magnetic fields (EMF) are present wherever electricity flows: around appliances and power lines, in offices, schools and homes. Electric fields are invisible lines of force created by voltage, and are shielded by most materials. Units of measure are volts per meter (V/m). Magnetic fields are invisible lines of force created by electric current and are not shielded by most materials, such as lead, soil and concrete. Units of measure are Gauss (G) or milliGauss (mG, 1/1000 of a Gauss). Electric and magnetic field strengths diminish with distance. These fields are low energy, extremely low frequency fields, and should not be confused with high energy or ionizing radiation such as X-rays and gamma rays.

Some studies have reported a weak association between estimates of residential magnetic field exposure and certain types of childhood cancer. These studies have not shown that the magnetic fields from power lines actually cause cancer. Some worker studies have also found associations between estimates of EMF exposure and some forms of cancer, but these results have been very inconsistent. Laboratory experiments have shown that exposure levels typically well above those normally found in residences can produce changes in cells, but there is little or no evidence that these changes constitute a health risk.

Electrical transmission and distribution line systems are not the only sources of magnetic fields. Within homes and work places, local sources of magnetic fields include building wiring and plumbing, electric blankets, electric stoves, computer terminals, bedside clocks, ceiling fans and other appliances that people may use for prolonged periods. It is noteworthy that some of the common sources of higher magnetic fields are appliances and electrical devices found within the home. The magnetic field levels from such sources in typical use can range up to thousands of mG or higher; however, the duration of exposure from many appliances is typically much shorter than that from other sources. Thus, exposure to both electric and magnetic fields occurs continuously, and is not simply a function of living or working near a power line or facility. Exposure depends upon the many sources and field strengths that are present where a person lives, works and otherwise spends time.

The electric and magnetic field strengths were calculated along a profile perpendicular to the transmission line. The total corridor width considered for the calculations is 70 feet, which equates to a distance of 35 feet from the center of the line to the edge of the right of way on each side of the line. The location of the profile is at the minimum clearance from the bottom phase conductor(s) to ground. This is typically at the mid-span between two consecutive transmission line structures. The minimum ground clearance is assumed, based on distribution under-build, to be 36.5 feet.

The "maximum" electric and magnetic field strength values are represented in this report. These values take into account the magnitude and phasor relationship of the three phase components of the electric and magnetic fields. This provides true values as a function of what would be measured in the field as opposed to RMS resultant values, which can be approximately 40 percent higher than these maximum field levels.

The electric field strength calculations were based on a maximum operating voltage of 5 percent above the nominal voltage level for all transmission lines. The magnetic field strength calculations were based on the maximum operating current in each power line.

4.1.2.2 Recommended Electrical Effects Design Goals

Numerous internationally recognized scientific organizations and independent regulatory advisory groups have conducted scientific reviews of the EMF research literature.[4] Without exception, these major reviews have reported that the body of data, as large as it is, does not demonstrate that exposure to power-frequency (60 Hertz (Hz) in the U.S.)

[4] CPUC/CDHS, 1989; IRPA/INIRC, 1990; ACGIH, 1991; EPA, 1990; EPA-SAB, 1992; CIRRPC, 1991; EMHEC, 1992; NRPB, 1992; Illinois, 1992; Colorado, 1992; Case, 1992; ORAU, 1992, 1993; INSERM 1993; Danish Ministry of Health, 1993; Universities Consortium on Electromagnetic Fields, Connecticut (February 1994); National Radiological Protection Board, United Kingdom (April 1994); American Medical Association (January 1995); American Physical Society (May 1995); American Cancer Society (January 1996); Virginia Department of Health (February 1996); National Academy of Sciences (January, 1997); NIEHS Director's Report to Congress (June, 1999).

magnetic fields causes cancer or other health risks, although the possibility cannot be dismissed. Most reviews recommend further research, and, appropriately, research in ongoing worldwide. The weakness of the reported associations, the lack of consistency, and the severe limitations in exposure assessment in the epidemiology studies together with the lack of support from laboratory studies were key considerations in the findings of the scientific reviews.

U.S. Federal EMF Program

In 1992, the U.S. Congress authorized the Electric and Magnetic Fields Research and Public Information Dissemination Program (EMF-RAPID Program) in the Energy Policy Act (PL 102-486, Section 2118). The Congress instructed the National Institute of Environmental Health Sciences (NIEHS), National Institutes of Health and the Department of Energy to direct and manage a program of research and analysis aimed at providing scientific evidence to clarify the potential for health risks from exposure to ELF-EMF. This program was completed in December 1998. In June 1999, NIEHS published its report (Health Effects from Exposure to Power-Line Frequency Electric and Magnetic Fields) with its findings and conclusions from this program of research.

The 1999 NIEHS report states the following in its conclusion section:

"The scientific evidence suggesting that ELF-EMF exposures pose any health risk is weak…. The NIEHS concludes that ELF-EMF exposure cannot be recognized as entirely safe because of weak scientific evidence that exposure may pose a leukemia hazard. In our opinion, this finding is insufficient to warrant aggressive regulatory concern."

Panels charged with recommending exposure limits for electric and/or magnetic fields have concluded that no meaningful experimental data exists (e.g., no dose-response information is available) on which to base standards or limits to which the public is exposed.

Induced Currents

The primary issue is how the induced or coupled voltages and currents on these objects can compromise safety to a person who is exposed to the object. Researchers have done extensive work in the area of perception of 60 Hz power system currents. The electrical effects on humans starts with perception and as current levels increase, let-go levels are next in importance. Higher current levels can lead to ventricular fibrillation and respiratory inhibition, which can cause death. Generally, for safety purposes, it is desirable to reduce the induced voltage and currents to levels that result in current flow through the body below the let-go threshold. Ultimately sufficient safeguards should be provided to reduce body currents below the perception limit. The reported perception of electrical current is a median level of approximately 1.0 milli-Amp (1/1000 of an ampere referred to in a condensed unit of “mA”). The let-go threshold is defined as the highest current (Root Mean Square which represents an average) flow in a hand to hand or hand to footpath for which a conductor held in a hand may be released. This threshold is extremely important since it defines a minimum dangerous current for the onset of an uncontrollable situation. The average let-go current for women and men was found to be 10.5 mA and 16.0 mA, respectively. In the smallest percentile for let-go currents measured, the currents have been reported to be as low as 6.0 mA for women and 9.0 mA for men. It has been estimated that 4.5 mA would be a reasonably safe let-go threshold for children. The National Electrical Safety Code (NESC) requires that power lines be designed to keep the induced current from nearby objects below 5.0 mA when short-circuited to ground. The short circuit current can be calculated for any object in or near the corridor to determine if the magnitude of the current is below the 5.0 mA rule for safety purposes.

The other situation in terms of electrical currents is a fault current. This would be a current, which flows to ground because of an abnormal situation on the power line such as a broken conductor. The fault current is primarily a function of the time it takes the utility to clear the fault. As the time of exposure decreases the body tolerance to current levels increases.

Fire and Fuel Ignition

Fires and possibly fuel ignition could result if there is a certain amount of energy. One example that is often analyzed is the fueling of a vehicle near a power line. It has been found that the amount of energy to cause ignition of a fuel mixture is in the order of 0.25 millijoules. These energy levels are possible from a high voltage line but for a fuel mixture to be ignited, there are other conditions that would have to occur as follows:

- The vehicle being fueled would have to be well insulated from ground,
- The spout of the fuel container would have to be well grounded, and
- The fuel mixture would have to be a certain proportion and concentration of gases.

It is generally recommended that fueling operations do not take place within the transmission line right of way.

4.1.2.3 EMF Prediction Modeling

Bonneville Power Administration’s Corona and Field Effects Program (CAFEP), a public domain software, was used to model and calculate the electric and magnetic fields produced by the proposed 69kV line. CAFEP calculates the electric and magnetic field values of the transmission line based on the conductor specifications and configuration as well as the current flow through the conductor. The result is a cross-sectional calculation of the corridor running perpendicular to the direction of the line. Results can be viewed in graphical form by placing the lateral distance from center on the X-axis of a chart and the calculated field value on the Y-axis.

4.1.3 Environmental Consequences

4.1.3.1 Transmission Line Operation

Table 4.1-7 represents the effects of electric induction in terms of the induced currents on various types of objects. The table gives the maximum electric field strength at the edge of the right of way and the induced currents in typical objects, which are either permanently or temporarily located along the corridor. Also indicated in the table for reference purposes, is the NESC 5.0 mA guideline for the clearance of power line conductors from the objects located near the line.

The highest induced currents from the transmission line would be in large buildings and long fences. Table 4.1-7 indicates that the maximum induced current in common objects that were assessed (assuming the characteristics for these objects) would be approximately 0.314 mA.

The maximum electric field strength in the corridor is approximately 0.63kV/m. The maximum field occurs at the centerline of the corridor. At the edge of the right of way, the maximum electric field strength is approximately 0.14kV/m.

Table 4.1-7 Transmission Corridor - Induced Currents in Objects

Object	69kV Overbuild		NESC
	ROW E_{fld}	I_{sc}	Rule
	(kV)	(mA)	(mA)
Large Tractor Trailer	0.136	0.088	5
Large School Bus	0.136	0.054	5
Farm Tractor, Small	0.136	0.041	5
Ford Pickup Truck	0.136	0.015	5
Automobile – Midsize	0.136	0.015	5
Automobile – Compact	0.136	0.013	5
Large Building (50' Wide, 100' Long, 20' Height); Non-Conductive Structure and a Conductive Roof	0.136	0.314	5
Large Building (50' Wide, 100' Long, 20' Height); Conductive Structure and a Non-Conductive Roof	0.136	0.272	5
House or Small Building (25' Wide, 60' Long, 10' Height); Non-Conductive Structure and a Conductive Roof	0.136	0.092	5
House or Small Building (25' Wide, 60' Long, 10' Height); Conductive Structure and a Non-Conductive Roof	0.136	0.080	5
Wire Fence with Wood Posts Length = 1,000'	0.136	0.067	5
Wire Fence with Wood Posts Length = 5,280'	0.136	0.356	5

The maximum magnetic field strength for the proposed line is approximately 72.7 mG along the centerline of the corridor. The maximum magnetic field strength at the edge of the right of way is approximately 41.3 mG.

4.1.4 Electrical Effects Control Measures

4.1.4.1 Transmission Line Operation

Electric Induction - General

The magnitude of electric field strengths from proposed line will not produce significant induced currents in objects near the corridor. The NESC requires a 5.0 mA limit based on the clearance from the transmission line to objects in proximity of the line. It is also known, that an induced current level of 1.0 mA can be perceived by human beings. Typically, grounding the object will eliminate the possibility of a person being subjected to induced currents from these objects.

The issue of exposure to magnetic fields from current carrying sources has been the subject of debate for many years. There are no proven health effects of magnetic fields from electric power facilities such as power lines. Magnetic field strength is a function of current flows in the line as well as conductor and phasing configuration. If there is a concern about reducing magnetic field strength some common mitigation schemes such as alternate conductor and phasing configurations could be investigated to study potential mitigation.

Electric Induction - Structures

Typically, buildings and storage sheds will not be permitted within the utility corridor, and are not a particular concern. However, lower electric field strengths also can exist outside of the corridor and buildings outside of the corridor should be considered. For structures outside the right of way, it is easy to reduce the potential for startle or annoyance possibilities by attaching a ground wire to the metal roof. This protection also provides a measure of lightning protection for the structure. Buildings entirely made of metal are not normally of any concern because they are often inherently well grounded, but exceptions might exist for structures on wood foundations or on a high-resistance material. Again, it is usually a simple matter to ground such objects if necessary.

In the same manner, rain gutters on a large house fairly close to the transmission line could conceivably deliver a perceptible shock to a person on an aluminum ladder. Quantitative worst-case analysis of any particular case can be difficult, but it is possible to determine if reducing the potential for perceptible shocks is a prudent precaution. It is a simple procedure to attach a wire to the downspout and ground it to a metal water pipe or a driven ground rod to mitigate shock effects.

Electric Induction - Fences

Long fence wires that are strung on wooden posts can present shock possibilities if they run more or less parallel and close to the transmission line. The insulation quality of the wooden posts is the controlling parameter. Perpendicular fences will have significantly less induced current and voltage. When exposed to the weather, even wooden posts are not perfect insulators. The lack of insulation will reduce the induced voltage on a fence wire and will limit the magnitude of a spark discharge. Nevertheless, some fences could be insulated enough by the posts to make contact currents annoying when the fence is touched. This type of fence would have to be close to the line and quite long before it produced annoying currents.

Long fences are often grounded by contact with growing vegetation. If grounded in this manner, electric field effects will be reduced, although magnetic field effects will remain unaffected. The possibility of annoyance due to electric field induction could be eliminated by solidly grounding the fence at a single point, such as with a metal fence post.

For an "electric fence," this is accomplished with a special filter designed to drain only the induced charge. However, a fence that is grounded at one or more points and otherwise insulated along a sufficient distance could present some opportunity for noticeable magnetic field induction effects. Reducing the potential of these effects requires electrically breaking the fence into smaller grounded sections.

The insulation of a person's shoes does not always reduce the current he receives due to electric field induction on a fence or any other conductive object; however, currents due to magnetic field induction are very sensitive to a person's shoe resistance. Shoe resistance will usually limit magnetically induced currents to an insignificant level. On the other hand, if a person is not well insulated from the ground (e.g., barefoot and on damp earth), there is a greatly increased chance for significant magnetically induced current on contact with a long fence.

There is no known incidence of injury due to induction on fences. Nevertheless, as a precautionary measure and to preclude annoyances, both magnetic and electric field induction effects can be potentially reduced by grounding at periodic distances along fences and by breaking the electrical continuity of long fence wires that are close to high-voltage transmission lines.

Electric Induction – Agriculture Equipment

Agricultural equipment can have dimensions approaching those of large road vehicles and as such can be subject to similar electric field induction levels. In practice, the conductivity of tires and good contact with the soil usually insures that electric field induction on farm equipment is seldom perceived.

Irrigation systems often incorporate long runs of metallic pipelines, which can be subject to magnetic field induction when located parallel and close to power lines. Because of the pipes' contact with moist soil, electric field induction is generally negligible, but annoying currents could still be experienced from magnetic coupling to the pipe. Pipe runs laid at right angles to the line will minimize magnetically induced currents although such a layout is not always feasible. Common mitigation measures are grounding and/or insulating the pipeline runs.

Operation of irrigation systems beneath power lines presents another safety concern, particularly for systems that can project the water to conductor height. This concern is not caused by induction, but rather by the possibility of direct contact by conductive water. The water stream from a high-pressure nozzle generally consists of a solid and broken-up portion. If the solid stream contacts an energized conductor, electric current conducted down the water stream may be hazardous to someone contacting the nozzle. Line contact by the broken-up part of the water stream is unlikely to present any hazards.

Although there are these legitimate concerns regarding irrigation systems, the only known and unfortunately not infrequent cause of serious accidents is inadvertent contact to lines by upended irrigation pipes, often during an attempt to remove a small field animal that has crawled into the pipe. For this reason, irrigation pipes that are very close to any power line should be moved with caution. The pipes must never violate a safe electrical clearance space around line conductors.

Magnetic Induction - Pipelines

Metallic pipelines can be within the transmission line right of way. Magnetic fields penetrate the ground and significant impacts can occur with long pipelines (there is not an established length but typically pipeline lengths more than 1,000 feet become more of a concern). Maximum voltages on the pipeline occur where there are discontinuities in either the transmission line or pipeline. When the transmission line and a pipeline are interacting, such discontinuities take the form of rapid changes in:

- Separation between the pipeline and transmission line
- The termination of the pipeline or an insulating junction in the pipeline (which amounts to the same thing)
- Sudden changes in pipeline coating characteristics
- A junction between two or more pipelines or transposition of transmission line phases

Note that the induction effects on pipelines during normal power line operating conditions are small compared to the induction effects experienced by a pipeline during a power line fault. The most severe kind of fault is a single phase-to-ground fault, during which high currents circulate in one of the power line phases and are not attenuated by any similar currents in other phases. Hence, fault reduction methods that suffice for single-phase fault conditions are often adequate for other conditions. In spite of the relatively low magnetic field levels during steady state conditions, induced voltages on an unprotected long metallic structure can reach hundreds of volts. The highest magnetically induced voltages occur for a fault condition since the currents in the line can be an order of magnitude greater than the normal or emergency load current. Even with extensive grounding systems connected to the structure, pipeline potentials can be on the order of dozens of volts, with hundreds of amps flowing in the structure. This constitutes primarily a shock hazard, which can be transferred miles away from the parallel corridor. In magnetic coupling studies, it is important that power lines as far away as 1,000 feet or more from the power line under study be given serious consideration.

Generally, there are three techniques to reduce the potential for high magnetically induced voltages below unsafe levels for fences, pipelines and railroad track systems:

- Sectionalize the conductor system – electrically isolate the pipeline, fence, etc. in sections to keep the voltages down to a minimum without the opportunity to build up over long distances.
- Ground the conductor system – put grounds on the conductor system at key locations where the conductor system and transmission line change characteristics and locations relative to each other.
- Buried fault reduction wires – install another system of parallel conductors to the pipeline, fence, etc. at key locations to allow the voltages of the multiple conductors to equalize to a common potential thus creating a low potential difference across a person's body that will not be unsafe.

Fire Hazards

The proximity of the transmission line to objects in or near the corridor can be susceptible to fires because of one of the following effects:

- A direct flashover to the object if the object is less than a minimum clearance to cause an electric arc between the line and the object

- A spark discharge on the object as a result of an increase in voltage between the object and ground

Air has a very high electrical insulation value (capable of sustaining up to 30,000 volts per centimeter) which aids in reducing the susceptibility of an arc discharge occurring. It has been determined that a voltage around the line of 100,000 volts is required to cause wood (such as a tree) to burn (the assumption is that the wood is moist). For a 69kV line, this would require that the wood object was less than three feet from the line. Therefore, it is prudent to clear brush, trees and other combustible materials that are less than three feet from the line.

Aviation Safety

Federal Aviation Regulations, Part 77, establishes standard for determining obstructions in navigable air space and sets forth requirements for notification of proposed construction. These regulations require notification for any construction over 200 feet above ground level. In addition, notification is required if the obstruction is less than specified heights and falls within restricted air space in the approach to airports.